The Dynamics of Alcohol and Marijuana Initiation: Patterns and Predictors of First Use in Adolescence

A B S T R A C T

Objectives. This study, guided by the social development model, examined the dynamic patterns and predictors of alcohol and marijuana use onset.

Methods. Survival analysis and complementary log-log regression were used to model hazard rates and etiology of initiation with time-varying covariates. The sample was derived from a longitudinal study of 808 youth interviewed annually from 10 to 16 years of age and at 18 years of age.

Results. Alcohol initiation rose steeply up to the age of 13 years and then increased more gradually; most participants had initiated by 13 years of age. Marijuana initiation showed a different pattern, with more participants initiating after the age of 13 years.

Conclusions. This study showed that: (1) the risk of initiation spans the entire course of adolescent development; (2) young people exposed to others who use substances are at higher risk for early initiation; (3) proactive parents can help delay initiation; and (4) clear family standards and proactive family management are important in delaying alcohol and marijuana use, regardless of how closely bonded a child is to his or her mother. (*Am J Public Health*. 2000; 90:360–366)

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Alcohol and marijuana are among the substances most commonly used by American adolescents,[1] and their use increases risks for a range of serious adolescent health and behavior problems.[2–6] Studies indicate that alcohol and marijuana use often begin early.[4,7–10] In the 1997 Monitoring the Future Study, a nationwide survey, more than 54% of respondents reported that they had consumed alcohol, and 23% reported that they had used marijuana, by the eighth grade.[1]

The age at which one first drinks alcohol or tries other substances is predictive of later problems with these substances, with earlier use placing individuals at greater risk for later abuse.[3,10–16] Age at alcohol initiation was strongly linked to later alcohol misuse in the sample examined here.[17] Age at initiation has also been shown to be a key mediator of other predictive factors for subsequent alcohol misuse.[17] Furthermore, studies have demonstrated that alcohol and marijuana use are important precursors to the use of other drugs.[15,18–22] Kandel et al.[18] reported that age at onset of alcohol use is a strong predictor of progression to other drugs. These findings underscore delaying onset of use as an important target for prevention efforts.

A number of studies have identified risk factors for alcohol and marijuana initiation. Boys appear to be at greater risk for early initiation than girls.[4,7,23–26] Antisocial beliefs and values may also place youth at increased risk.[27,28] Low parental monitoring has been found to predict children's initiation of substance use at earlier ages,[29,30] as has a low level of attachment to parents.[31] Exposure and attachment to substance-using peers are also strongly predictive of increased risk for early initiation.[8,31–34]

A few studies have attempted to identify the ages of greatest risk for alcohol and marijuana initiation. Kandel and her associates,[4,7] on the basis of reports obtained retrospectively from a cohort of young adults followed up in 1980 and 1981, plotted hazard rates by age for the onset of alcohol and marijuana use. These plots showed that, although nearly 20% of the cohort had initiated alcohol use by the age of 10 years, the risk of onset (among those who had not yet initiated) climbed steeply throughout adolescence, with the hazard rate peaking at 0.87 by 18 years of age and declining steeply thereafter. The risk of marijuana initiation also peaked at 18 years of age (at 0.20), but the decline was more gradual into early adulthood. Other studies have identified early adolescence as a particularly risky period for initiation, specifically among Native American and African American youth.[9,35]

The present study builds on these previous reports by examining the dynamic patterns and predictors of alcohol and marijuana initiation in a longitudinal sample. Given the role of adolescent onset in predicting later substance use problems, it is important to extend previous retrospective research by exploring prospectively when recent cohorts of young people are at the greatest risk for initiation and how this risk changes over the course of development. Furthermore, it is important to extend studies of static risk factors to understand the etiology of initiation itself in a multivariate and theoretical context and to understand the dynamics of the phenomenon of initiation. These were the objectives of the analyses presented here.

The social development model provided a framework for examining etiology.[36–38] This model integrates key features of control,[39] social learning,[40] and differential association[41] theories to specify the roles of parental and

peer influences, social bonding, normative beliefs, and other factors predictive of children's behavior. In brief, the model hypothesizes that children learn patterns of behavior, whether prosocial or antisocial, from socializing agents such as family members, peers, and others. The influence of each agent operates through socialization processes that encourage either prosocial or antisocial behavior. While the social development model incorporates multiple domains of influence, the present analyses focus on individual, family, and peer constructs.

Methods

Sample

In September 1985, 18 Seattle elementary schools were identified that had overrepresentations of students from high crime neighborhoods, according to police records. The study population included all fifth-grade students who attended these schools (n = 1053). From this population, 808 students (77%) consented to participate in the longitudinal study and constituted the Seattle Social Development Project sample. This acceptance rate is comparable to the rates of other studies attempting to recruit children or adolescents.[42–44]

Data were collected in the fall of 1985, when most participants were approximately 10.5 years of age (median = 10.7, mean = 10.8, SD = 0.52); in the spring of each succeeding year through 1991; and in the spring of 1993, when most participants were aged 18 years. Early in the study, students completed group-administered questionnaires in their classrooms and received a small incentive (e.g., an audiocassette tape) for their participation; later they were interviewed in person and received monetary compensation. The interviews were approximately 1 hour in length.

Approximately half of the sample was exposed to a multicomponent preventive intervention in the first 2 years of the study (see Abbott et al.[45] for a description and analysis of the intervention). Because previous analyses suggested differences between groups, the initiation rates presented here note differences between the intervention and control groups. However, other analyses indicated that the covariance structures among social development model constructs and substance use outcomes were substantially similar between the 2 groups.[37] Thus, etiologic models are presented for the full sample.

The sample was balanced in terms of sex (412 male students and 396 female students). Racial/ethnic composition was 46% White American, 24% African American, 21% Asian American, 6% Native American, and 3% from other racial/ethnic groups. A large portion of participants were from relatively low-income households. Median annual family income for the sample in 1985 was approximately $25 000. Forty-six percent of parents reported a maximum family income below $20 000 per year, and more than half of the student sample (52%) had participated in the school free-lunch program. Forty-two percent of the sample reported only one parent present in the home in 1985.

Measures

Initiation. Alcohol initiation was the first point at which a participant reported having "ever drunk beer, wine, whiskey, gin, or other liquor." In 1990 (when participants were aged 15 years) and later, this question was revised to include "other than a sip or two." No notable shifts in pattern of initiation or hazard
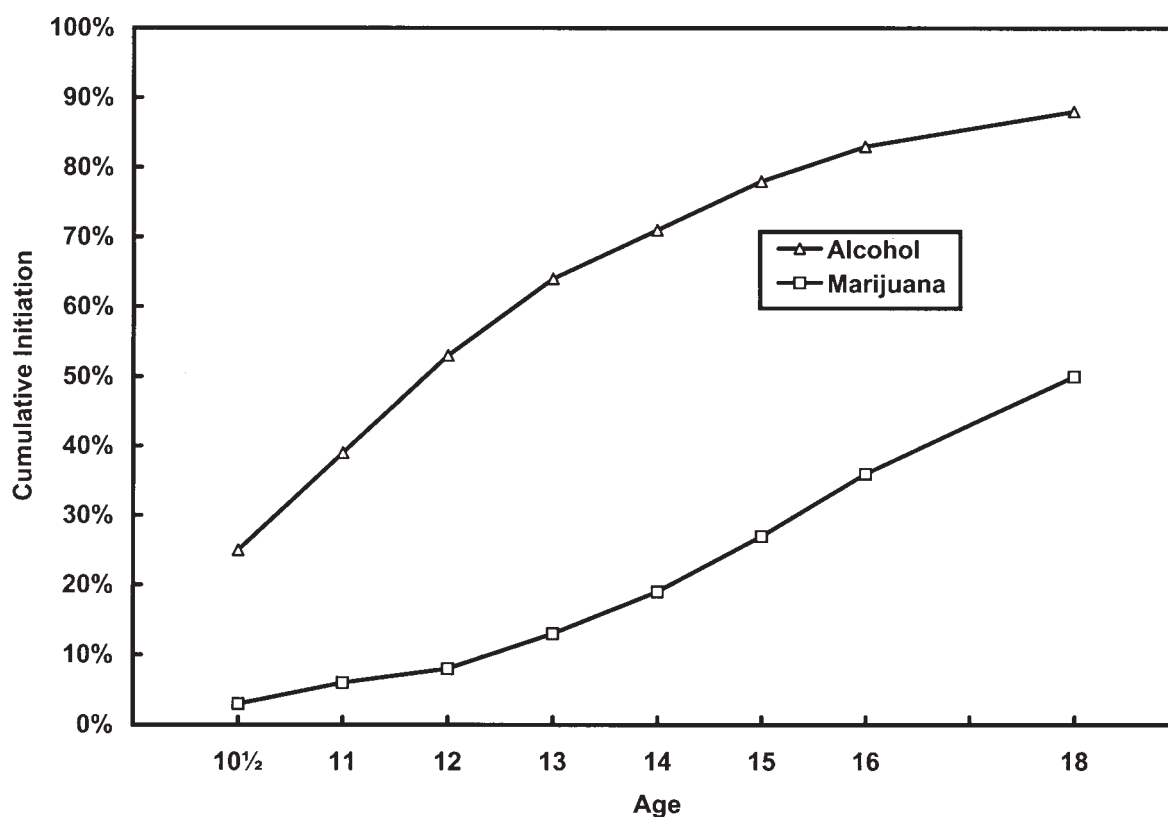

FIGURE 1—Cumulative alcohol and marijuana initiation, by age: Seattle Social Development Project, 1985–1993.
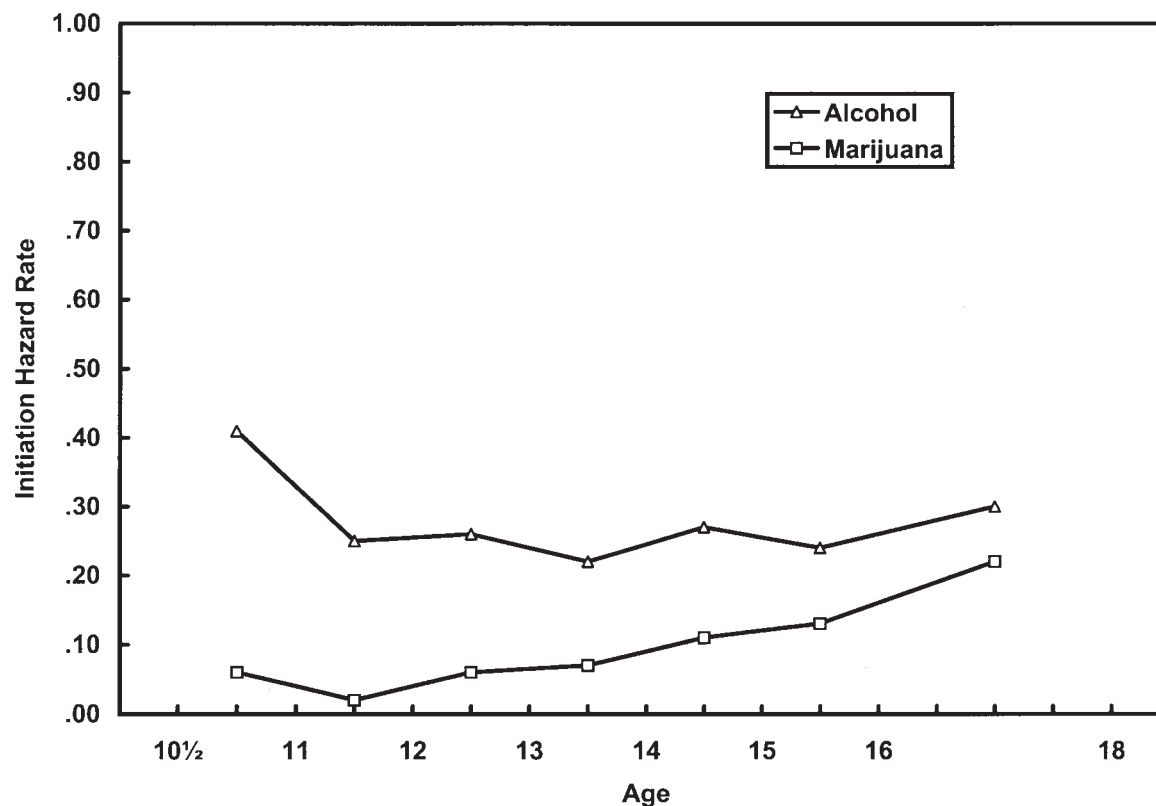
FIGURE 2—Hazard rates for alcohol and marijuana initiation (indicating risk of initiation for those who had not yet initiated), by age: Seattle Social Development Project, 1985–1993.

rates were found as a result of this wording change (see Figures 1 and 2). Marijuana initiation was the first point at which a participant reported having "ever smoked marijuana."

Predictors. Time-varying covariates were constructed to reflect key constructs of the social development model. The predictors described below were measured with the same items at each wave of data collection. Items were combined into scales by summing item responses and calculating means (mean alpha coefficients for the ages of 10.5 to 16 years are reported for scales combining 3 or more items).

Parents' proactive family management combined 6 items assessing parents' monitoring, rules, discipline, and reward practices (mean $\alpha = 0.69$).

Parents' substance use norms combined an item regarding parents' permissiveness and rules about alcohol and drug use, along with participants' perceived likelihood of being caught and punished for drinking alcohol or smoking marijuana. Two different measures were created: norms regarding alcohol use and norms specific to marijuana and other drug use.

Bonding to mother combined 2 items about sharing thoughts and feelings with one's

mother and desire to be the kind of person one's mother is.

Associate substance use was measured with 3 items referring to peer alcohol use (e.g., whether or not one's friends had tried alcohol; mean $\alpha = 0.69$) and a second combination of 2 items that asked about having acquaintances who used marijuana and whether siblings had used marijuana.

Participants' substance use norms combined 3 items asking whether the respondent thought it hurts people to drink alcohol or smoke marijuana and whether it is okay for someone his or her age to drink alcohol or smoke marijuana. Again, 2 different measures were created: norms about alcohol (mean $\alpha = 0.62$) and norms about marijuana (mean $\alpha = 0.64$).

Higher scores indicate more of the construct as labeled (i.e., better family management, stronger norms against substance use, more bonding, more substance use by peers and siblings). A list of the scales and items used in the analyses is available from the first author.

Procedures for Missing Data

In some cases, the exact age at initiation was unknown because of missing data; how-

ever, in most of these cases, the initiation age could be determined within a 2-year period. (Missing alcohol and marijuana initiation ages could not be identified within 2 years for 8% and 5% of the sample, respectively.)

To most accurately portray the phenomenon of initiation in these data, we used a data imputation program based on an expectation-maximization algorithm to estimate an initiation time point for participants among whom initiation had occurred but whose exact age at initiation was missing.[46,47] The imputation was based on the longitudinal patterns of responses to the initiation items for which data were present. (All participants who had not initiated by the age of 18 years remained right-censored; i.e., no initiation age was imputed.) The imputation approach was used to minimize bias relative to alternative procedures such as listwise deletion and mean substitution.[48]

When necessary, predictor variables also were imputed for participants among whom half or more of the items composing a scale were missing at a particular time point. Across all predictors at all ages, missing data averaged less than 9%. Missing data due to attrition were relatively few; nearly 94% of the participants in the origi-

nal fifth-grade sample were interviewed at 18 years of age.

Results

Alcohol and Marijuana Initiation

Figure 1 shows cumulative rates of alcohol and marijuana initiation. At the age of 10.5 years, 25% of the participants reported that they had tried alcohol, while 3% had tried marijuana. The initiation trajectories for alcohol and marijuana showed fairly different slopes through adolescence. Alcohol initiation rose relatively quickly up to about 13 years of age, by which point an additional 39% of the sample had used alcohol, for a cumulative initiation rate of 64%. From the ages of 13 to 18 years, however, the rate of increase in initiation began to slow; in this 5-year period, an additional 24% of the sample used alcohol for the first time. By 18 years of age, cumulative alcohol initiation had reached 88%.

In contrast, marijuana initiation remained relatively flat up to about 13 years of age; 13% of the participants had initiated by this age. Over the succeeding 5 years, however, the rate of initiation increased. By 18 years of age, about 50% of the sample had initiated marijuana use. Nearly 37% first used marijuana between the ages of 13 and 18 years.

Patterns of initiation were virtually the same for control and intervention groups for both alcohol and marijuana. With regard to alcohol initiation, 87.8% of the control group had initiated by 18 years of age, as compared with 87.7% of the intervention group; the mean ages at onset among those who had initiated were 13.3 and 13.4 years, respectively. No tests for differences in survival distributions approached significance (e.g., log rank $\chi^2(1) = 0.10$, $P > .75$).

Similarly, 50.4% of the control group had initiated marijuana use by 18 years of age, as compared with 49.4% of the intervention group; mean ages at onset were 16.7 years for both groups (log rank $\chi^2(1) = 0.06$, $P > .80$). While the intervention had significant effects on other outcomes (e.g., less lifetime violence, improved school bonding, less heavy alcohol use at 18 years of age[49]), results reported here are consistent with previous analyses that showed relatively few effects on substance use initiation rates.

Hazard Rates

Hazard rates based on the life-table method[50] are plotted in Figure 2. This figure shows the risk of initiating alcohol or marijuana use in each time interval for those among whom initiation had not occurred pre-

viously. Values represent hazard rates for initiating between data collection assessments.

For those who had not yet tried alcohol, the risk of initiation peaked early, before 11 years of age, and then remained roughly the same through the rest of adolescence. Among those who had not yet smoked marijuana, however, the risk of initiation steadily increased from 12 through 18 years of age.

Multivariate Prediction of Initiation

Many predictors we considered varied with time, underscoring the need to model predictors dynamically to best reflect the association between changing levels of potential predictors and initiation of use. With the exception of sex and race/ethnicity, each predictor was treated as a time-varying covariate such that the value of the predictor at one time point was used to predict initiation at the following time point.

Predictors were entered into a complementary log-log regression in a hierarchical manner according to their hypothesized proximity to alcohol and marijuana initiation in the social development model. More distal predic-

tors were entered first. Regression equations included a categorical assessment-time variable to control for differences in baseline hazard rates over time. Table 1 shows the order of entry of predictor constructs and the results for the final multivariate models. There were few differences in the magnitude or significance of coefficients in successive steps of the hierarchical regressions and the final multivariate models shown in Table 1.

Predicting alcohol initiation. There was no effect of sex on alcohol initiation in step 1, nor were there effects of African American, Native American, or other race/ethnicities; however, Asian American ethnicity reduced the likelihood of alcohol initiation in comparison with the reference group (White Americans). There was no effect of previous marijuana initiation in step 2. In this sample, only 9 participants reported initiating marijuana use before initiating alcohol use.

After control for sex, race/ethnicity, and previous marijuana initiation, parents' proactive family management significantly reduced the likelihood of alcohol initiation (B=–0.15, SE=0.06, $P<.05$; data not shown in Table 1). However, this effect of family

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TABLE 1—Survival Analysis With Time-Varying Covariates Predicting Alcohol and Marijuana Initiation (Final Complementary Log–Log Models): Seattle Social Development Project, 1985–1993

Step and Predictor	Alcohol Initiation		Marijuana Initiation	
	B	(SE)	B	(SE)
Step 1				
Sex (male)	0.09	(0.09)	0.24*	(0.11)
Race/ethnicity (vs. White American)				
African American	0.08	(0.10)	0.25*	(0.11)
Asian American	–0.42***	(0.11)	–0.74***	(0.15)
Native American	0.14	(0.16)	0.38*	(0.18)
Other	–0.01	(0.22)	0.00	(0.23)
Step 2				
Previous marijuana initiation	–0.49	(0.36)		
Previous alcohol initiation			0.72***	(0.14)
Step 3				
Parents' proactive family management	0.09	(0.10)	–0.29**	(0.11)
Step 4				
Parents' alcohol use norms	–0.24***	(0.07)		
Parents' marijuana use norms			–0.05	(0.07)
Step 5				
Bonding to mother	–0.06	(0.07)	–0.08	(0.08)
Step 6				
Associates' alcohol use	0.46***	(0.07)		
Associates' marijuana use			0.39***	(0.06)
Step 7				
Participants' alcohol use norms	–0.08	(0.08)		
Participants' marijuana use norms			–0.45***	(0.09)
–2 log-likelihood	2316.15		2196.18	

Note. Those initiating use before the age of 10.5 years were not included in the complementary log–log regression analysis. Analysis n=603 for alcohol initiation; analysis n=784 for marijuana initiation. Entries are based on final complementary model with all predictors included.
*$P<.05$; **$P<.01$; ***$P<.001$.

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management became nonsignificant when parents' norms about teen alcohol use were added to the regression. Parents who had stronger norms against teenage alcohol use reduced their children's alcohol initiation. Such norms may mediate the effects of family management practices. Bonding to mother contributed little after the effects of parental norms had been taken into account. However, alcohol use by associates and friends had a strong direct effect, increasing the likelihood of initiation after other predictors had been entered. After control for all of the preceding factors, participants' norms about alcohol use in the previous year had little direct effect on alcohol initiation.

In summary, with all of the factors considered simultaneously, Asian American ethnicity, parents' alcohol use norms, and associates' alcohol use directly predicted alcohol initiation (Table 1). The effects of these 3 factors did not appear to be substantially mediated by other factors included in the model. Only parents' proactive family management practices were significant at an earlier step but not significant in the final model.

Predicting marijuana initiation. The same complementary log–log regression model was examined for marijuana initiation. At step 1, male participants were more likely to initiate marijuana use. African Americans, Asian Americans, and Native Americans were all significantly different from White Americans, with African Americans and Native Americans more likely to initiate, and Asian Americans less likely to initiate, marijuana use. As suggested by the gateway hypothesis,[18] those who had initiated alcohol use were more likely to initiate marijuana use. This was a very common pattern of behavior: 309 youths reported alcohol initiation before marijuana initiation. Parents' proactive family management practices decreased the likelihood of marijuana initiation. However, parents' norms about marijuana and other drug use contributed very little beyond the effects of proactive family management. Bonding to mother had a modest, nonsignificant effect, tending to reduce the risk of marijuana initiation. Marijuana use by acquaintances and siblings, when considered after the other predictors, made a strong contribution to increasing the likelihood of initiation.

Finally, in contrast to their effect in alcohol initiation, participants' own norms against marijuana use showed a highly significant effect in inhibiting initiation even after all of the preceding factors had been considered. The direct links to marijuana initiation in the final multivariate model shown in Table 1 were from the following factors: sex; Asian American, African American, and Native American race/ethnicity; previous alcohol initiation; parents' family management practices; marijuana use by acquaintances or siblings; and adolescents' own norms about marijuana use. The modest effect of bonding to mother was notably diminished with the addition of associates' marijuana use and participants' norms about marijuana.

Discussion

This study examined the patterns and predictors of alcohol and marijuana use onset in adolescence. The cumulative initiation trajectories and hazard rates of each were notably different. The risk for alcohol use initiation spans virtually all of adolescence. Risk for marijuana initiation increases notably with age through the age of 18 years.

The pattern of risk for alcohol initiation in this recent sample differed somewhat from that reported by Kandel and her associates[4,7] based on their sample of New York State public school students assessed retrospectively in 1980 and 1981. While the present sample reported more initiation at earlier ages (e.g., 71% had initiated by 14 years of age, as compared with 50% in the New York sample), Kandel and associates reported an increasing risk through adolescence, with the hazard rate jumping to 0.87 by 18 years of age. These differences are probably due, in part, to retrospective measurement in the New York sample and to a legal drinking age of 18 years in New York at the time of the Kandel et al. study. The pattern of risk for marijuana initiation, on the other hand, was remarkably similar in the two samples given their generational and geographic differences; initiation risks were low in the preteen years and then rose steadily through adolescence, peaking at 0.20 and 0.22 by the age of 18 years in the New York and Seattle studies, respectively.

The different ways in which parents influenced alcohol initiation and marijuana initiation are of interest. As noted, parents inhibited alcohol initiation mostly through communicating clear norms against their child's use of alcohol. Marijuana initiation was discouraged mostly through parents' proactive family management practices. These differences may reflect different social norms with respect to these substances. Given the legality of adult alcohol use and widespread alcohol advertising, young people are likely to be exposed to norms that assert the acceptability of alcohol use. Therefore, what parents say (or do not say) to their children about teen alcohol use may be very important in establishing behavioral standards. These data underscore the need for parents to communicate clear expectations against alcohol use by teens. In contrast,

young people are likely to perceive a greater normative consensus opposed to marijuana use. To inhibit marijuana initiation, it appears important for parents to do a good job of managing and monitoring their children, which in itself may encourage adoption of broadly shared social norms against marijuana use.

Differences in social norms about alcohol and marijuana use may also help explain the different effects of individual or personal norms on alcohol and marijuana initiation. After control for other factors, young people's own norms about teen alcohol use were not significantly predictive of alcohol initiation in the following year, but their norms about teen marijuana use were strongly predictive of marijuana initiation. For both substances, use by peers or other associates was a strong predictor of initiation. These results suggest that personal norms about alcohol's risk and acceptability are vulnerable as guides to behavior when there is broad acceptance of teen drinking in the society and use by peers is prevalent. On the other hand, personal norms against marijuana use may guide behavior, in part, because they are reinforced by a perceived normative consensus in society against marijuana use. When one has strong personal norms, it may be easier to say no to marijuana than to alcohol, even if one's associates are using it, because it is perceived as less accepted generally.

Bonding to mother was not predictive of alcohol or marijuana initiation in either of the multivariate regressions. These analyses suggest that establishing clear family norms and practicing good family management can inhibit alcohol and marijuana initiation, regardless of how close young people feel to their mothers during this time of adolescent individuation, separation, and identity formation. Our findings underscore the importance of not giving up on clear standards and good parenting, even if teenagers express anger, antipathy, or distance in response to their parents' efforts to influence them toward healthy behaviors.

The results reported here have important implications for prevention efforts. Given the role of early initiation in precipitating later substance use problems, delaying age at initiation is an important goal for prevention. This study indicates the following: First, prevention efforts should span the entire period of adolescent development. The preteen years may be particularly appropriate for alcohol-focused work, and the later teen years may be particularly appropriate for marijuana-focused work. Second, parents can play an important role in delaying initiation through proactive family management and communication of strong family norms against alcohol

use. Third, strong family norms may be particularly important when norms in the larger society about a behavior vary widely from approval to disapproval, as is the case with alcohol use. Fourth, strong personal norms against substance use can help inhibit the initiation of behaviors widely disapproved in the larger society, such as marijuana use. Fifth, parents should be encouraged not to give up on clear family standards and proactive family management, even if adolescents withdraw some degree of attachment. These parenting practices appear to inhibit initiation even when attachment wanes. Finally, prevention efforts must directly address the influences of peers, siblings, and other acquaintances who use substances.

Prevention efforts targeting parents' family management practices and norms regarding adolescent substance use are promising, but both of these components may be necessary to prevent early initiation of licit and illicit substances alike given different societal norms regarding different substances. The degree to which specific family prevention efforts may be differentially effective for different substances is a promising area for future research.

Limitations of this study should be noted. Analyses were based on self-reports. While some studies raise questions about the accuracy of self-reports when the behavior in question is illegal or undesirable,[51] research comparing different measurement strategies has indicated that self-report surveys administered privately and confidentially can provide reliable and valid data.[52] Moreover, in previous work, we found similar predictive relationships for self-report outcomes and other reports provided by school district and juvenile court records.[49]

The sample in the present study tended to be from lower-income families and was more ethnically diverse than would be expected from a representative national sample. Despite these differences, alcohol initiation rates by 18 years of age (in 1993) were virtually the same as rates in the corresponding survey of 12th graders from the national Monitoring the Future Study in 1993 (88% and 87%, respectively). Alcohol initiation rates at 16 years of age also closely matched those of 10th graders in the 1991 Monitoring the Future Study (83% and 84%, respectively).

However, the Seattle Social Development Project sample reported higher initiation rates for marijuana: 50% at the 18 years of age (vs 35% for 12th graders in the 1993 Monitoring the Future Study) and 36% at 16 years of age (vs 23% for 10th graders in the 1991 Monitoring the Future Study).[53] (The Monitoring the Future Study has noted

somewhat higher rates of marijuana use in the western states than in other regions.)

It is also important to note that in the Seattle Social Development Project sample, in comparison with the Monitoring the Future Study national sample, African Americans appeared to have initiated alcohol and marijuana at higher rates relative to White Americans. We found no significant differences between these racial/ethnic groups in alcohol initiation rates and significantly higher marijuana initiation rates among African Americans in the Seattle Social Development Project sample; however, the 1993 Monitoring the Future Study reported more alcohol (89% vs 81%) and more marijuana (36% vs 24%) initiation by 18 years of age among White Americans than among African Americans.

A notable difference between these studies is the omission of high school dropouts from the Monitoring the Future Study, while they were included here; this may partially account for some of the differences in the findings. However, we have no reason to expect that the relationships between predictors and drug use initiation reported here would differ dramatically in other samples. Research is needed, of course, to replicate our findings in other samples. □

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